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A Centralized Financial Reporting System for Improved Data Access and Analysis

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A Centralized Financial Reporting System for Improved Data Access and Analysis

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Abstract

Throughout the Department of the Navy, accurate and timely understanding of the command's business financials is critical for decision making. The inability to directly connect data analytics applications to financial data sources and the availability of multiple sources for data results in large variability in the information reported and significant time to download and pre-process the data.

The Naval Undersea Warfare Center, Keyport Division developed the Centralized Financial Reporting (CFR) system that allows analysts to access multiple datasets required for financial management. The cleaned and validated datasets are available via SharePoint and a Power BI Premium workspace. Ready-to-use files, dataflows, and semantic models stored in these workspaces allow for immediate visualization and data analysis, resulting in a significant time savings and an estimated cost savings of more than a million dollars on these tasks. Additionally, easy accessibility to transaction-level details allows a quick evaluation of the contributors to the financial health of Keyport business.

In this paper, the CFR system is described and evaluated, including the three concerns it's use mitigates: the significant resources required for financial reporting, difficulty evaluating factors affecting information garnered from the data, and discrepancies in reporting that are experienced with the current methods used to evaluate business financials.

Introduction

As the Department of the Navy (DoN) works towards being both accountable and transparent in financial matters, limitations in some of the financial systems have hindered the meeting of some financial reporting goals (DoN, 2024). As would be expected, similar difficulties persist across the warfare centers (WFC).

At the Naval Undersea Warfare Center (NUWC), Keyport Division, direct connections to business financial data via data analytics applications do not exist, resulting in the need to download, clean, pre-process, and validate the data from multiple data sources on weekly or monthly bases. This significant burden on the analysts reduces their ability to focus on in-depth analyses of the data or requires them to work outside of their schedule hours.

In attempts to reduce this burden, summary tables are often pulled from the data sources. As would be expected, the use of summary tables restricts the ability to delve into the transaction-level data. Without access to the transaction level data within a dashboard, additional work is required to further evaluate the data for any reason (e.g., ad hoc data calls that are not answered with the summation tables or errors in the summation tables).

The last concern resulting from the lack of a direct connection to the data is that additional data sources have been created that pull data from the authoritative data sources to make access to the data easier (e.g., business financial transactional data is accessed through DoD Resource Planning [DRP], DoD Data Warehouses [DDW], and Jupiter [DoN, n.d.-a]). This results in potential discrepancies between reports and dashboards created with the different data sources. The reasons for the discrepancies are varied but may result from the timing of the data being made available or errors contained in one data source but not in another.

To mitigate data access concerns across the Navy, the DoD and DoN have created Advana Jupiter, an enterprise data and analytics environment (Booz Allen Hamilton, n.d.; DoD, n.d.; DoN, n.d.-b). Currently, Jupiter is working to provide users access to DRP data through both the analytics applications housed within Jupiter and via outbound connections (DoN, n.d.-a; DoN Chief Information Officer, 2020). At the time of this writing, the DoD has paused development on Advana, which is the DoD environment that houses Jupiter (Williams, 2024). Once it has been made accessible, it is anticipated that this will be a preferred method of accessing DRP data. Until then and the time when all required datasets are available in Jupiter, the Centralized Financial Reporting (CFR) system will make data accessible at NUWC Keyport. This system is described below.

Objective and Approach

Datasets

NUWC Keyport Program and Financial Analysts rely on several data sources to report the financial health of the projects they monitor. As a Working Capital Fund (WCF), the data sources of interest include DRP, DDW, DoD Planning System (DPS), Enterprise Quoting System (EQS), DoD Work Management System (DWMS), DoD Investment Reporting System (DIRS), and Excel spreadsheets on individual analysts' computers.

DRP is the authoritative data source for every charge that has been applied (i.e., transactions) or is anticipated (commitments and obligations) to be applied. From DRP, several reports can be obtained. Two commonly used reports are the Actual Transactions table and Actuals Obligations table. The Actual Transactions table details every transaction, whereas the Actual Obligations table details the commitments and obligations. Although DRP is the authoritative data source for financial transactions, the data contained within it can be difficult to parse out. Therefore, some analysts will choose to get data from DDW because it provides a cleaned and processed view of the data. DDW can also be used to obtain categorical data that will provide analysts more information regarding the information contained in the Actual Transactions table or Actual Obligations table. For example, the Labor Charge Category table out of DDW provides more information about the labor charges (e.g., breaking out overtime and regular labor data) but the Actual Transactions table does not. Additional tables that can be pulled from DDW include the Network Categories table that provides categorical data for each network like the network title and center code associated with network and the Sales Category table that provides information about each sales order (e.g., the network associated with a sale, the purchaser, date of purchase, etc.).

In the budget planning arena, DPS, DQS, WMS, and DIRS are used by different teams at NUWC Keyport based on factors such as the customer and product being produced. Therefore, there is no single authoritative data source for the budget planning. An additional consideration is that some monthly phase plans have historically been documented in Excel and sent by email for aggregation and visualization of the planned and actuals. Therefore, to obtain the same information for each of the projects reported in the Power BI visuals, the CFR system includes Microsoft Power Apps for analysts to enter their monthly phase plans. The Power Apps provide a method for easy project planning data entry into the CFR system. The apps also allow

the analysts to make corrections and updates to plans, and to allow an “at a glance” view of a particular plan without accessing a second application.

The last set of data is obtained from the Finance office, including static factors, cost elements, work centers, and allocations tables. The static factors table provides the analyst with daily, monthly, and yearly anticipated workyear (WY) factors. By using these factors, the WYs for each timeframe can be calculated by dividing the hours by the factor. The WYs are split up by regular and overtime (OT) charges. The cost element table provides categorical data about cost elements (or items that were purchased), e.g., title and category of the cost element. The work center table provides information about the department, division, and branch associated with the work center. The allocations table provides information about the funds budgeted for overhead and service funds.

Data Access and Storage

Data access options were investigated. As stated above, direct connection to the required data sources from our system is the preferred method; however, none of the data sources listed above currently allow a direct connection. Jupiter provides a possible indirect access solution. As we work to obtaining access to this connection, we opted to proceed by downloading the data to a location that could be accessed across command.

Several storage solutions were investigated including cloud storage options (e.g., Azure), SharePoint, and on prem databases. SharePoint was chosen for the reasons outlined below.

1. The relatively small size of the datasets (< 10 GB).
2. The prohibitive time and financial requirements for the procurement of cloud storage or database solutions.
3. The readily available and “freely” accessible SharePoint storage via Flank Speed.
4. SharePoint being a Microsoft solution with connectors available for easy connectivity to other Microsoft applications (i.e., Power BI, Power Automate, and Power Apps).

Having determined the required datasets and the storage locations, we downloaded, validated, and uploaded the data into SharePoint. The data was obtained from the sources indicated in Table 1.

Table 1. Datasets and Data Sources

Dataset	Data Source
Actual Transactions	DRP
Actual Obligations	DRP
Financial Plans	Analysts via MS Power App/SharePoint
Network Categories	DDW
Labor Charge Categories	DDW
Sales Categories	DDW
Workyear Factors	Finance
Purchase Categories	Finance
Work Center Categories	Finance
DOD Workyear and Financial Allocations	Finance
Investment Planning	DIRS

Power BI Dataflow

After the data was stored in SharePoint, Power BI dataflows were created. Power BI dataflows allow for entire datasets to be cleaned, processed and made available for use in Power BI desktop or Power BI online. It also provides increase security by preventing access to the underlying data (Microsoft Learn, 2024b). It is important to note that the dataflows are available on the Power BI premium services (Microsoft Learn, 2024b).

To date, seven dataflows were created that include the data housed in SharePoint. The dataflows are as follows: Actual Transactions table, Common Dimension Tables, Dates and Factors, Net Operating Result (NOR) analysis, Phase Plans, and WKYRs. The Actual Transactions table dataflow consists of the aggregate of all Actual Transactions tables pulled from first use of DRP to current. The Common Dimension Tables dataflow consists of the Network Categories, Sales Categories, Purchase Categories, Work Center Categories, DoD WYs and Financial Allocations, and miscellaneous crosswalk tables. Dates and Factors includes a dates table (i.e., a table of all dates from 2012 to 2030) and WY factors table. The NOR dataflow contains miscellaneous tables related to the Commands ability to hit the NOR target by the end of the fiscal year (FY). The Phase Plan dataflow contain the aggregated phase planning tables for all FY starting in FY25. The WKYRs dataflow contains the aggregated Labor Charge Categories tables from first use of DRP to present. The dataflows will be augmented with additional datasets as categorical data for different funding types are obtained.

Power BI Semantic Model

Using the Power BI dataflows, two Power BI semantic model were created (investments and overhead/service) and a third one will be created in FY25 for direct funds. A Power BI semantic model is a set of one or more tables that have been cleaned and related in the Model view of Power BI desktop (Microsoft Learn, 2024a). It provides the user access to the cleaned and preprocessed data with defined relationships between tables, allowing users to focus on visualizations and report creation. The semantics models are made available via the Power BI Premium service. An example of a Power BI Semantic model is illustrated in Figure 1, which shows the Overhead and Service model used in the CFR system.

Figure 1. Illustration of the Overhead and Service Semantic Model in Power BI

These semantic models can be downloaded from the Power BI Premium Service workspace to another Power BI workspace or an individual's OneDrive workspace. The download provides access to both the semantic model and any visualizations attached to the model, allowing the user to create new or modify existing visualizations.

Power BI Visualizations

Using the CFR system, all the data described above is accessible by analysts across command to analyze and create reports. The SharePoint Lists and Excel workbooks allow the use of any application to analyze and create visualizations of the data. Using the Power BI dataflows and/or the Power BI semantic data model, analysts can connect to the data via Power BI Desktop or Power BI online.

Currently, Keyport analysts have been working with the Power BI semantic model and have created many visualizations of the Overhead, Service and Investment financials. To illustrate the capabilities of the system, the Overhead and Service visualizations that are currently available in the command-level Tableau (Tableau Software, 2024) dashboards were recreated in Power BI. Further, to illustrate the power of making transaction-level data available, additional reports were created that allow an analyst to drill into the data to answer more specific questions regarding the health of their portfolios (e.g., Overtime Analysis, Service Revenue Analysis, drill-throughs into each transaction, etc.).

Previous, NUWC Keyport command-level reports have been created using Tableau software (Version 2024.2.2). Figure 2 illustrates the existing command dashboard while Figure 3 illustrates that the CFR system houses a similar visualization. Figure 5 illustrates the data that is not available with the Tableau visuals but can be quickly extracted from the CFR system.

Figure 2. Tableau Dashboard that is Currently Being Used on Station Contains a Bar Chart, a Line Chart, a Bar/Line Combination Chart, and Aggregated Financial Information

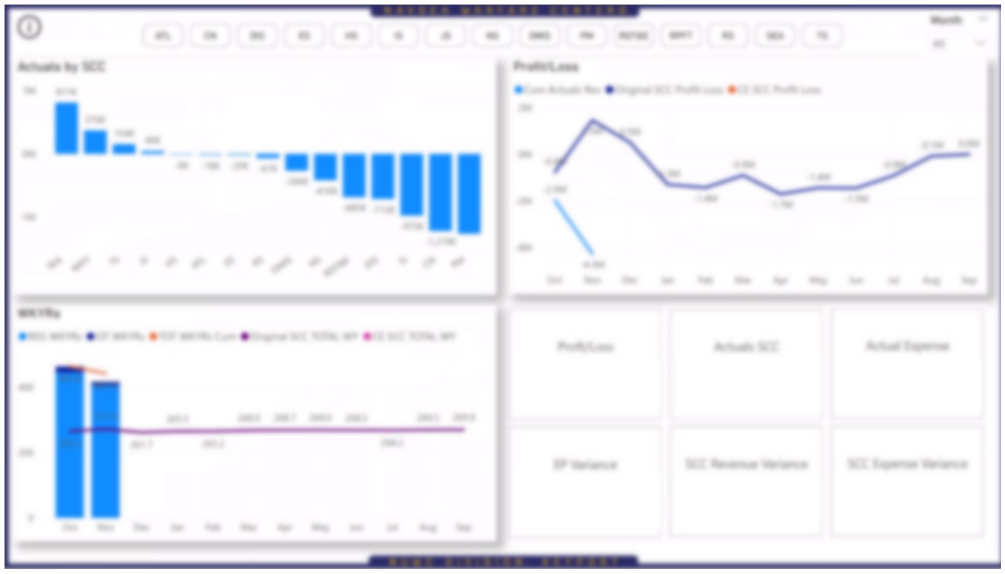

Figure 3. Service Analysis Power BI Report Illustrates the Ability to Mimic the Existing Tableau Dashboards

The Service Revenue Analysis Power BI Report (Figure 4) illustrates the granularity that can be provided. This report provides the user with Service specific revenue by type, by the Purchase Category name, and by the department providing the revenue. Previously, this information was not readily available to the line analyst. Instead, the analyst would have to take significant time to comb through Excel spreadsheets to gather the data illustrated in Figure 4. Then, they would have to find the crosswalk that would link the network to the owner of the funds. For an experienced analyst, this could take several hours. For a new analyst, they might not know how to get this information. With CFR, the analyst no longer has to do the extra legwork. They can drill into the data, as needed.

Figure 4. Service Revenue Analysis Power BI Report Provides the Ability to Delve into the Data in a Way that is Not Currently Available in the Tableau Dashboard

The Revenue Analysis (Figure 5) shows how you can now drill into the data to extract important information that was not available previously. In this example, the amount paid to a Service fund for a specific cost element can be determined per department on station. Although this shows information at the departmental level, the information can also be shown at the division, branch, and even network level.

Figure 5. Revenue Analysis Illustrates the Ability to Drill into the Data

CFR Inputs and Outputs

Up to now, we have discussed the various components of the system. Figures 6 and 7 illustrate the entire CFR system. Figure 6 illustrates the inputs to the CFR system including the data input by the analysts on project phase planning, the data obtained from DRP, DDW, the Finance office, and DIRS. This data is then stored in SharePoint either as a List or as an Excel Workbook in a SharePoint folder. Using this data, Power BI dataflows are created, then using the dataflows, the Power BI semantic data models are created. It is important to note that the analysts have access to the data at each of the four input stages. This allows them the freedom to use other data analytics and visualizations programs other than Power BI, as well as the ability to choose their preferred way of accessing the data. In Figure 7, four different CFR output options are illustrated: in-depth data analytics, customized Power BI reports, command-level Power BI reports, and Power BI Apps that allow for aggregation of several different Power BI report sets. The last option provides stakeholders and leadership to access several different reports and dashboards via a single URL. This would be beneficial for command-level leadership, who keep track of many different financial reports across the command.

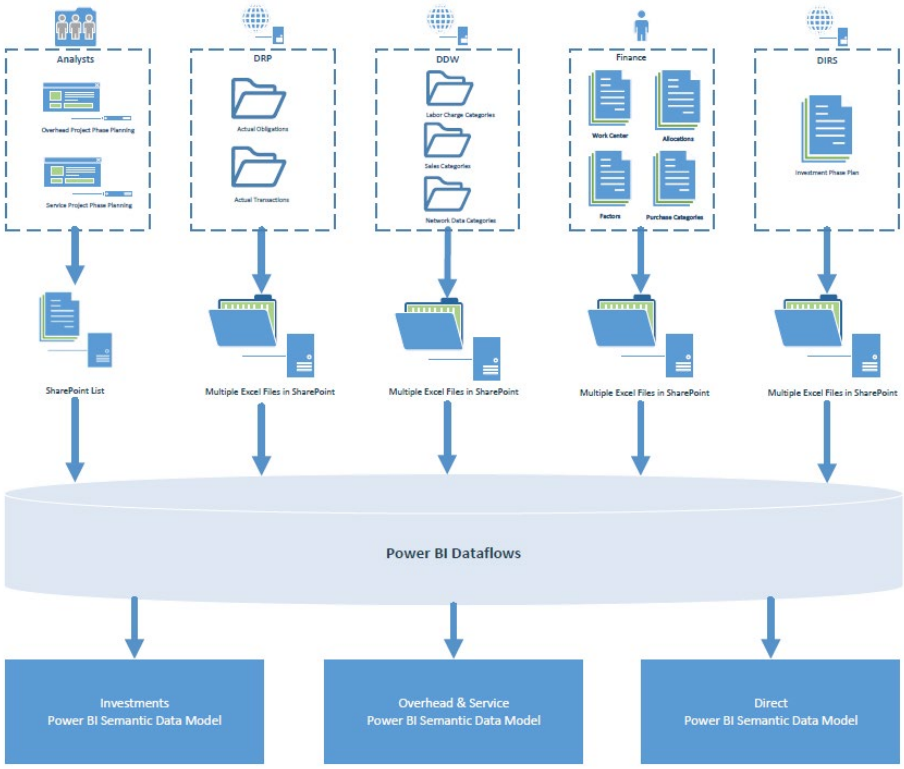

Figure 6. CFR Data Inputs and Processing

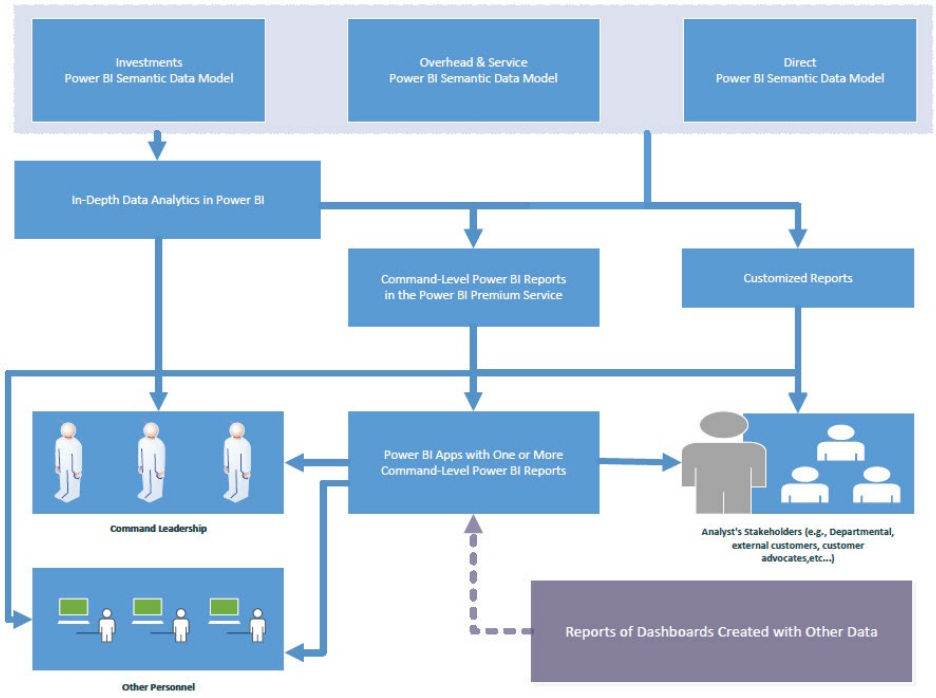

Figure 7. CFR Data Analytics and Power BI Reporting Options

Key Insights

Use of the CFR system has the potential to improve financial reporting across the NUWC Division Keyport and potentially across other warfare centers. These improvements come in the form of a reduction in time and resources for compiling financial information, an increase in the level of detail that can be obtained from the data, and reduction in discrepancies in reporting. Although not yet discussed, it is important to note that to achieve these benefits, training is required. As such, a training program is being developed as outlined in the training section.

Reduction in Time and Resources

Financial reporting at NUWC Keyport requires the analyst to obtain data from sources of record, clean the data, then analyze and create any required reports. The time to complete this varies from analyst to analyst based on the number of data sources, the amount of data, the analyst's technical expertise in automated data cleaning options, and the number of ad hoc data calls the analyst receives. For periodic reporting, this might take hours to days for OH or Service monthly reporting, and eight hours per week for direct weekly reporting. The ad hoc data calls can add a significant amount of time to their monthly or weekly reporting time because of the need to comb through the data to get the necessary information. It also requires a level of data expertise that newer analysts may not possess, resulting in the inability to provide the required information.

A significant benefit of the current system is the reduction in time needed to create the periodic and ad hoc reports. This is accomplished by eliminating the need to access and clean the data. To quantify this time saving, the Pareto principal (Pragmatic Editorial Team, 2024) can be used. In data science, it is estimated that it takes 80% of the time to clean and prepare the data and it takes 20% of the time to conduct the analysis. With this in mind, the new system has the potential to reduce report creation time by roughly 80%.

If every analyst on station puts in 8 hours/week for data preparation and analysis. The current system would reduce this time by 6.4 hours/week. To estimate the cost saving in labor dollars, a few assumptions will be made.

1. An analyst costs $158/hour.
2. There are 35 analysts.
3. There are 48 work weeks/year.

Based on these assumptions, this would result in a savings of almost $1.7 million/year on analysts work related to cleaning and pre-processing data. The time savings would allow analysts to focus on improving their data analytics skills, providing better insights of the data, training new analysts, and addressing their work backlog. It also has the potential to improve the analysts' morale because of the reduction in overtime needed and by providing a sense of being able to successfully accomplish their tasking.

It is important to note that these are estimates are based on the assumptions that have been outlined. Several factors may affect these calculations, including the need to conduct additional analyses (e.g., some analysts may need to add a Data Analysis Expression [DAX] measure or two to obtain the information requested by their stakeholders). Additionally, an individual will need to pull the data into the system and make sure the automated processing has been completed accurately. The weekly data pulls and processing takes roughly 3–5 hours/week. This cost would have to be added back into the above estimates. This would add roughly $40,000 back into the above estimates. In light of the $1.7 million in estimated savings per year, this is negligible.

Increased Granularity in Available Data and Reporting

Increased granularity in the data is provided by making the transaction-level data available. Currently used reporting mechanisms do not allow for deep dives into the data, resulting from the use of summary tables or other methods used to create the reports. Unfortunately, this method obscures the underlying data.

By making the transaction-level data and dimension tables available, the information can be presented in a way that is more comprehensible. For example, the unique identifier of a Purchase Category is a number that does not convey what that purchase category is unless a crosswalk is available that links the number to the name of the Purchase Category. In the current system, we have provided a semantic model that links the Purchase Category dimension table to the tables with transaction-level data. This allows the analyst to quickly create reports that provides information that is easier to consume without needing to pull the additional table. A secondary benefit is that a newer analysts can use this comprehensive dataset to learn how to answer some of the more complicated data calls that previously required a detailed knowledge of the datasets, where the data was stored, how to access the data, and what questions the datasets could help answer.

Finally, the use of transaction level data allows the analyst to quickly evaluate any errors in the data or inconsistencies between two reports. Within Power BI reports, it is possible to create pages that allow the analyst to drill into the data in a visualization to see the underlying data that is included in the aggregation. This can then provide the analysts with information about what is included in the aggregation, and potentially what data is producing the erroneous result(s).

Reduction in Report Discrepancies

Discrepancies in reporting have previously caused significant time to be spent to determine the source of the discrepancies. Common sources were the use of different data sources and the use of summary tables. Copying and pasting the data incorrectly into tables was another source.

To reduce the discrepancies, the CFR system provides centralized access to the data and semantic data model. The semantic data model pre-links the transaction-level data to dimension tables used to provide categorical information that allows for easier comprehension of the data. This allows the analysts quicker access to the data, improving the chance they will use the same validated data. Additionally, the use of the semantic model with defined table relationships provides the less experienced analysts with the ability to start creating visualizations without an in-depth understanding of the required relationships.

Training

As we strive to reduce the burden of accessing and pre-processing data, we have created a system that uses Power BI dataflows, semantic models, and reports. Although the system reduces the pre-analytic processing, it also incorporates technology that is relatively new to the analysts on station and introduces complexities of its own (e.g., accessing a semantic model or connecting to a Power BI dataflow on the Power BI premium service). To help analysts learn the new system and to encourage its use, training sessions are being developed. This training will be provided as a part of an existing Power BI training series. The training consists of basic information on how to use Power BI Desktop and Power Query, as well as information about the data housed in the Power BI dataflows, information about the connections and how best to use them, and hands-on instructions on connecting to the CFR data, using the provided visuals and creating new ones.

Limitations

While the CFR system addresses several of the hurdles that analysts at Keyport traverse, not all concerns have been addressed. As stated in the introduction, direct access to all the datasets would be the ideal option. This would reduce the need of someone downloading the data. Instead, a Power BI dataflow and semantic model could be created from a direct connection to the data at the source (e.g., by connecting to DRP instead of to the files downloaded from DRP). Additionally, it will reduce the possibility of any errors introduced in the download step.

Conclusions

Management of the financial portfolio of a WCF is time consuming and costly because of the complexities of this type of fund. The NUWC Keyport CFR system was developed to significantly reduce the time and cost of managing these portfolios, by providing analyst access to all relevant data from a central location. This data is validated and preprocessed and is also directly accessible via Power BI for reporting purposes. By making this preprocessed, comprehensive dataset easily accessible, Keyport analysts can spend more time on in-depth analyses and report creation, providing their stakeholders the reports necessary to make well-informed and sometimes critical decisions.

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